Shots and Shells. 29-1

If the world will go on fighting, we of the peaceable class may at least try to understand what the Quixotes are about. With this view we have inquired curiously into the nature of the missiles which, with the aid of villanous saltpetre, they let fly at one another; and the replies we have received enable us to give some account of those diabolical messengers of battle, that "hurtle through the darkened air," under the name of shots and shells.

The term shell, in military language, signifies a hollow globe of cast iron, the centre cavity being destined to contain either gunpowder alone, or a mixture of gunpowder and bullets; if the latter, the shell is termed a shrapnell, from the gallant captain, its inventor; and also a "spherical case-shot." When filled with gunpowder alone, it is simply a shell, or occasionally a bomb-shell.

The ordinary shell, or bomb-shell if the reader pleases, is a very old invention, dated from at least the beginning of the sixteenth century, and attributed with strong probability to the Venetians, who employed this missile with great effect against their enemies, the Turks. Its construction is sufficiently simple, consisting as it does of a hollow cast-iron sphere, with an aperture plugged at pleasure, just as a bottle is with a cork. The contents of this round iron bottle are gunpowder, and the intention is, that at a certain period the powder shall ignite and burst the shell into fragments, spreading far and wide, committing sad devastation, by virtue of their projectile force; in addition to which, the ignited gunpowder sets fire to any combustible body with which it may come in contact.

When the shell is projected from a gun, and has arrived at, or, at any rate very near, the object intended to be struck, the ignition is accomplished by means of a contrivance termed the fuse. Now every child who has amused himself with a squib or a blue-light, will easily comprehend the nature of a fuse, which is a hollow cylinder of wood or metal, stuffed hard with a comparatively slow-burning powder or composition not capable of explosion, but occupying a certain definite number of seconds before it can reach the internal charge. When shells were first introduced, and for a long time subsequently, they were shot out of short, stumpy pieces of artillery denominated mortars. At present, they are not thus restricted, all but the very largest being now shot out of cannons and howitzers—the latter a sort of compromise between a cannon and a mortar.

It will be perceived that the regulation or timing of a fuse—in other words, the adjustment of its length, in such a way that its fire may communicate with the central charge exactly at the proper instant—is a matter requiring delicacy of hand, much calculation, and much experience. If explosion takes place too soon, the whole effect of the discharge is lost; if too late, then the missile is no better than a common round shot. Thus, at Waterloo, many of the French shells did no further harm than bespatter our troops with dirt, on account of the great length of their fuse. The shells, failing to explode in the air, fell and buried themselves in the ground, where finally bursting they spouted up torrents of mud; and that was the extent of the damage they effected.

Perhaps, now, the reader will ask how the fuse is lighted. Why, by the blast of the gun itself—although the discovery that it might thus be lighted was the result of accident. For a long time subsequent to the introduction of shells, the fuse had to lighted as a preliminary operation—a perilous arrangement; for if the gun missed fire, woe to the gunner!

Many attempts have been made, within the last few years, to effect the ignition of shells without the aid of fuse—that is to say to ignite them on the principle of the percussion cap; and if this could be accomplished, they would acquire a great accession of power for many special purposes. Many cases may be imagined in which a shell of this kind would possess a manifest advantage over the common sort; for example, when brought to bear upon ships. The mere bursting of a shell near a ship is not necessarily attended with serious consequences; but the great point to be achieved would be the explosion at the very moment of the contact. The explosion of so large a quantity of gunpowder upon or within a ship's timbers would be productive of an effect so easy to understand, that it need not be described. This consummation is scarcely likely when shells with fuses are employed, seeing that the very force of concussion has a tendency to extinguish the fuse, to say nothing of the chances in favor of a shell's bursting before it arrives in dangerous propinquity to the ship.

All attempts to apply the percussion principle to shells have, so far as relates to artillery, been futile. If the problem of rifling the bore of cannon, however, was solved, there would be no difficulty in the case; for these projectiles, as a matter of curiosity, have been frequently shot from rifled small arms, and have exploded on striking their object, with almost unfailing certainty.

Having described the ordinary shell, it might seem natural that we should proceed at once to the shrapnell; but certain reasons, the nature of which will be presently evident, induce us to preface that description with some notice of canister-shot. Has the reader ever seen a tin case of preserved provisions? No doubt he has; and he will therefore be at no loss to understand the nature of the canister-shot. Instead of a mere tin plate, let him imagine one of sheet-iron; instead of dainty provisions, let him fancy the case stuffed full of small iron balls, something larger than musket balls; and he will then have a good notion of canister-shot.

Now the sheet-iron canister, although quite strong enough to withstand all the knocks, bumps and other disturbing contingencies of transport, is by no means strong enough to withstand the explosive force of gunpowder; hence, no sooner is it discharged from a cannon, than its walls splitting asunder, liberate the bullets, which are then scattered just like a charge of small shot. The devastating effect of this projectile may be readily imagined; but its range is insignificant. Perhaps a distance of three hundred yards may be considered the most effective. Many of us have, doubtless, heard the assertion made, that a musket will kill a man when fired at the distance of a mile; nor, perhaps, is the assertion incorrect, if we make one trifling proviso, namely, that the man aimed at be hit. But the effective range of a musket is scarcely more than a hundred yards; that is to say, if a musket, properly charged, screwed in a vice for the purpose of maintaining its exact line of aim, pointed at a target a yard square, and a hundred yards distant, be fired many times in succession, the target will be invariably hit, although not by any means in the same spot. At a distance of six hundred or seven hundred yards the bullet might be deflected to the extent of a hundred yards in any direction; and at the distance of a mile its deflection would be so great as to go beyond calculation. Nothing like accuracy of aim, we repeat, can be depended upon with the musket beyond the distance of a hundred yards. From a consideration of this circumstance, it follows that artillerymen, with comparative impunity, may discharge canister-shot against a platoon of musket-armed infantry. The Minie rifle, however, and, indeed, many other varieties of rifle, are capable of hitting a mark at eight hundred yards' distance, and even more, with greater certainty than a musket at a hundred yards; and, therefore, long before a piece of artillery could be brought within canister range, its horses and gunners would be crippled or killed, and the gun thus rendered ineffective. Hence it follows, that since the introduction of the Minie rifle the advantages of canister shot are far less than they formerly were under the old musket system.

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We are now prepared to enter upon the consideration of the shrapnells, or spherical case-shot. Let the reader picture to himself a common bomb-shell, not filled with powder alone, but with a mixture of gunpowder and bullets; as many of the latter being first inserted as the shell will hold, and the gunpowder thrown in afterwards until all the interstices are filled up. Let him furthermore imagine an instrument of this description to be supplied with a fuse, and he will have a true notion o the terrible shrapnell-shell, or spherical case-shot.

From a consideration of the various parts of which this missile is composed, he will see that, being discharged from a cannon, it first travels like a common round-shot; but a certain range having been described, and the burning fuse having ignited the gunpowder within, it will burst in pieces, with all the effect of a canister shot. The shrapnell, then, admits of being regarded as a canister-shot intended to take effect at a very long range; and the greatest nicety is required in apportioning the effective length of the fuse at that distance. In practice, this apportionment is effected by means of a "fuse augur" or borer, which scoops out determinate lengths of the composition. The effective range of such shell is very great; they will do good execution at one thousand or fourteen hundred yards, and are highly dangerous at still greater distances; thus, as it would seem, conferring on artillery a preponderating advantage over the Minie rifle.

Still, we must not conceal the fact, that the question as to this comparison is still open. The Minie rifle has scarcely been tried in the open field of war. During the progress of the seige of Rome, it did good execution against artillery; the *Chasseurs de Vincennes*, armed with the Minie rifle, having kept up such a destructive fire against the Roman embrasures, that the artillerymen could not stand to their guns.

In the open field, it is argued by the opponents of the Minie rifle, canon would have the advantage, inasmuch as the latter, instead of being stationary, and thus affording a constant mark for the sharp shooters, would be constantly altering their distance, and thus disturbing the aim of the enemy. No doubt, the remark has much truth in it—but how much, only actual practice in the field can determine. The fact, however, is certain, that the general introduction of the Minie and other long range rifles, will rob canister-shot of much of their terrors; indeed, some experienced men urge the total abandonment of the latter in favor of the shrapnell shells, the fuses of which can now be regulated with such accuracy, that their explosion at any given distance, compatible with their range, may be absolutely depended upon.—*Chambers' Journal.*

Philadelphia, Thursday, Nov. 16, 1854.

LOCAL AFFAIRS. 29-3

The New Gas Works.—The new works in the First Ward (late Passyunk) are so nearly compled, that by the first of December they will be entirely finished and ready for the manufacture of gas. The ground owned by the city is about 74 acres, with a front on the Schuylkill of 1500 feet, 400 feet of which has been improved with a substantial wharf; the lower end beginning at the point where the Passyunk road strikes the river. The works were commenced in July, 1851, and since that period have progressed whenever the weather was fit, under the superintendence of Mr. John C. Cresson, Chief Engineer, and his able assistants, Dr. C. M. Cresson and Alexander Massey. In the summer of 1852, the laying of the 20-inch main, which now connects with the old works in Market street, was commenced, and on the 24th day of August last was completed. The length is 18,730 feet, or upwards of 3½ miles. The other buildings required for the manufacture of gas are all finished, and the interior arrangements nearly so. They have been erected with much care and in the most substantial manner. The retort house especially is an object of much interest. It is built of a gray cast of stone, 250 feet long, 50 feet wide, 56 feet high to the peak of the roof, and 28 feet high inside to the top of the gutter cornice. There are 48 gothic windows, each 12 feet high, in it, constructed of cast-iron frames, and with the gutter cornice and adornments above and below it of iron ore, painted to represent a gray stone. The roof, which is supported by a light iron truss work, is covered with slate. On each side of the building is a porch 25 feet square, designed for entrances and for shelter for the workmen from the heat.

As yet but one retort bench has been constructed—on the east end of the house. This is 107 ft. long, 20½ feet wide and 10½ feet high, and contains cells for 72 retorts, three on each bed. The retorts are 9 feet long, 20 inches wide and 15 inches high, of the D shape, 15 inches longer than those ordinarily in use. They are connected in the usual way, with hydraulic mains 16 inches wide, and 16 inches high, also of the D form. Each sett of 12 beds, is furnished with a pair of 14 in. washers, arranged in such a manner as to admit the substitution of sulphuric acid washers, for those of salts of ammonia, such as are now used, if it is deemed advisable to make the change on the score of economy. A novel feature in the bench of retorts is, that each bed has its independent chimney, a plan which has been found cheaper in the erection of works, and more favorable to the heating of the apparatus than to employ independent draughts for each—the small additional force of draught given by a tall chimney not repaying its cost of erection. The retorts are to be supplied with coal conveyed to them in trucks on a small railway built for that purpose, and by the same means the coke will be removed.

The next building into which the gas passes is the engine and purifying houses, one hundred feet distant, through pipes of ample dimensions. This building is built in the shape of an L, seventy-two feet front on Passyunk road and fifty-two feet deep. The engine room is 30 feet long and 26¾ feet wide, and contains a set of six exhausters, two sets of cylinder wet lime purifiers, and a six horse-power vertical engine. Each exhauster consists of a cylinder eight feet high, two-and-a-half feet diameter, bolted down upon a heavy bed plate.

In the centre rises an inner cylinder, 14 inches in diameter and 4 feet high, having upon its upper end a valve opening upwards, the lower end communicating with a pipe leading from the retort house, before referred to. In the annular ring or space left between the two cylinders, works another cylinder of boiler iron, closed at the upper end by a valve opening upwards, and is attached to a piston-rod passing through a stuffing box on the head of the large cylinder. The annular space is filled with water, and forms a seal or packing without friction. The piston-rods attached to the cylinders are connected with cranks to the engine, and from the upper edge of the outer cylinders, pipes conduct the gas into the wet lime washers or purifiers. There are two sets of wet lime purifiers, each 5 feet in diameter. These consist of cylindrical boxes enclosed at the top and bottom, partially filled with cream of lime. The gas enters by pipes attached to the top, and passes beneath the surface of the liquid. It is kept in contact with it as long as possible, by a horizontal plate extending nearly to the sides of the box, and passing round the edges of the plate, escapes from the liquid into the box above, and is then conveyed to the condensers. The lime and water are constantly agitated by bars driven by the engine.

There are 54 condensers, each 18 feet long and 6 inches in diameter, arranged in 9 drip boxes, in the usual manner. The next process is passing the gas from the condensers into the dry lime purifiers previous to admitting it into the metres and gas holder. The setts now in place have been removed from the old works, where they were used several years. There are 8 boxes, each 15 feet long, 5 feet wide and 2 feet high.

The meter house is 60 feet from the purifying house, and is 10 feet long and 30 feet wide. The inlet for the pipe is 16 feet in diameter, leading into a meter 11 feet 4 inches in diameter, and 11 feet 2 inches long.

The outlets are two in number, each 12 inches in diameter, leading to the gasholder and to the 20 inch main which conducts it up into the city. The meter-room is 27 by 61 feet in the clear, with two circular end rooms, designed for offices. There will be two additional meters of the same dimensions as that above described, besides two of 8 feet square, now in use at the old works. The gas-holder is 100 feet from the meter-room.

The gasholder is 90 feet high and 162 feet long. It is supported by 12 pentagon towers, of beautiful construction, each 92 feet high. It is of the telescopic pattern and was commenced on the 12th of January, 1853, and on the 20th of September of the same year, the outer section was lowered. The inner or upper section is 158 feet 6 inches in diameter, and 45 feet deep, with hydraulic cup or seal, 20 inches deep by 6 inches wide. The side, including the cup, is composed of 22 rows of sheets of Nos. 10, 11 and 12 iron, joined together by button-head rivits, at intervals of 1 inch each. It was kept in shape by an angle iron frame, supported by 24 cast-iron legs or uprights. The legs were in the form of the letter D, cast in five sections of 9 feet each, and bolted together, while a score 6 by 10 inches runs the whole depth of the side, so as to admit of loading of the gasholder, with any extra pressure required. Each row of sheets contains 84 distinct pieces, and the section 1848 sheets.

The crown of the upper section is composed of No. 12 sheet-iron, laid in 16 circles, with upwards of 2000 sheets. It is supported by a king post of boiler iron, 7 rings of angle and bar iron, and 24 trusses of round and square iron from ¾ to 1½ inches thick. The trusses contain 2,678 pieces. On the crown of the holder are 6 manhole plates and 2 bonnets for stand-pipes, with an elevation of 4 feet. The outer or lower section is 160 feet in diameter, and 45 feet deep, with a cup similar to the upper section. The side has also 22 rows (1848 sheets of iron) varying in thickness from No. 10 to No. 14, and rivitted together like the other. In the two sections, 490,000 pounds of wrought-iron were used and 175,000 pounds of cast-iron—total 665,000 pounds, or nearly 300 tons of iron. There were 687,934 rivits used in the construction of the holder, and for the purpose of facilitating the driving of them, all the holes were bored previous to being removed from the manufactory.

The heavy snow storm of February 20th, 1854, or some other unforseen accident, caused the upper section of the gasholder to fall, occasioning a loss of several thousand dollars to the city. As soon after as possible a number of workmen were employed to repair the injury, and for that purpose all the interior works were removed, as well as the sheets from the top. All of the latter, however, but about 50, were found to be in a condition, after being rolled, to be replaced, and a considerable portion of the truss-work inside. Next week the work of repairing the gasholder will be completed and ready for the introduction of gas.

In these new works Philadelphia has a gas-works superior to any in the world, and a gas-holder larger than any ever before constructed. Like the last gasholder constructed at the old works, it is on the telescopic principle, and contains 1,800,000 feet of gas—eight hundred thousand cubic feet more than the one at the works at Twenty-second and Market streets, and one million cubic feet more than the mammoth gasholder in London.

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The works are supplied with water from the Schuylkill by a Worthington pump, 10 inch cylinder, which raises the water into a cistern 50 feet high.

The Gas Works in the late District of Spring Garden.—We gave in Friday's Ledger, statistics of these gas-works, showing their financial condition. 29-5 We now present a description of the works, now all completed. There are two retort houses; one is 190 feet long by 30 feet wide, and contains 21 ovens, with 3 retorts in each oven, and the other is 164 feet long by 30 feet wide, and contains 18 ovens, with 3 retorts in each oven, making in all 117 retorts. These buildings are constructed with a basement story 10 feet high and fitted for a store-house, with the necessary ventilation to prevent the coal from taking fire, and is capable of holding 3000 tons of coal. The roofs of these houses are constructed of iron and slate, and are perfectly fire-proof. Two purifying houses, 54 by 23 feet in the square, 18 feet high, covered with slate on a truss frame of wood, with 4 purifying boxes, 6 by 14 feet in the square, and three cylinders, 2 feet in diameter by 12 feet high, with two jets of water playing in each to wash and separate the impure properties from the gas, and 2000 feet of 10-inch pipe, through which the gas passes or is conducted between the washers and purifying boxes, which gives a sufficient condensing surface to make the gas perfectly cool by the time it gets in contact with the lime. Also, 2 station meters and 2 governors of sufficient capacity to register and regulate 300,000 feet of gas in 24 hours; two sheds to prepare lime for purifying purposes, and three coal-sheds capable of holding 4000 tons of coal; 2 scales of 2400 lbs. each, to weigh the coal for charging retorts, and one large cart scale for weighing coal and other materials bought for gas purposes. Also, a carpenter shop, 18 by 24 feet in the square, 16 feet high; 1 storehouse, 16 by 20 feet square, 18 feet high, and 1 office-house, 20 by 40 feet square, two stories high; 2 telescopic gas-holders, 1 of 100 feet in diameter by 60 feet high, and the other of 62 feet in diameter by 40 feet high; both together capable of holding 590,000 cubic feet of gas.